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Procedia Economics and Finance 8 (2014) 53 – 59

Procedia Economics and Finance

www.elsevier.com/locate/procedia

1st International Conference 'Economic Scientific Research - Theoretical, Empirical and Practical Approaches', ESPERA 2013

Regional disparities of the Romanian energy system

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Abstract

The paper highlights the regional disparities of the Romanian energy system, evaluated from three different perspectives: the generation utilities structure within the eight country development regions; the human resources endowment; the economic and financial situation of the energy companies administrated by each region. Also, our research envisages the regional development perspectives for the national energy system in terms of production units that should be decommissioned in order to comply with the environmental regulations that Romania agreed with the European Commission. The analysis revealed that, despite a national level structural equilibrium triggered by a diversified structure of primary energy resources, the energy systems' situation at regional and microeconomic levels indicate an important lack of balance between the country regions. Main determinants and effects are depicted in this paper

Keywords: Energy system, regional development, primary energy resources endowment, labor disparities

1. Introduction

Although a regional analysis may be regarded as less useful giving the network character of the electricity industry, the arguments favouring this approach come from the possible impact of an unbalanced geographical

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doi:10.1016/S2212-5671(14)00062-8

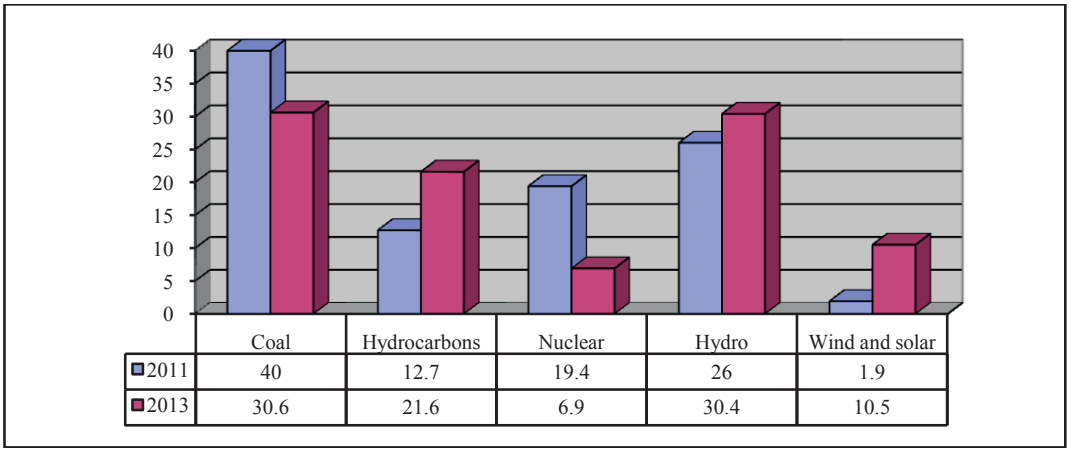
structure of generation units on: (i) distribution and transport networks security (the appearance of network congestions) and (ii) on regional employment possibilities for energy specialists.

The regional disparities were estimated using three indicators: the labour and energy generation capacities endowment of the regions and the losses/profits of the companies administered by each Romanian development region.

2. Research results

The installed capacity, production and consumption structures have constantly modified in the past 20 years, the main coordinates being the continuous decrease of the thermal plants contribution to the supply along with the expansion of the wind farms and the diminishing of the electricity production because of the final consumption decrease.

The available energy resources determine the configuration of the generation capacities. Nationally, the energy system has changed, in only two years, its structure towards a more equilibrated contribution of different energy resources to the electricity production (in 2013 the average of the absolute deviations of the data points from their mean was 9 compared to10 in 2011). (figure1)



	Coal	Hydrocarbons	Nuclear	Hydro	Wind and solar
2011	40	12.7	19.4	26	1.9
2013	30.6	21.6	6.9	30.4	10.5

Figure 1. The Electricity production structure, by energy resources, in Romania, in 2011 and 2013
Source: for 2011 www.insse.ro; for 2013 www.transelectrica.ro

Comparing to 1989, when Romania had only one electricity generation company, in 2011, the national energy system benefited from 26 electricity producers. The main electricity generation companies were Complexul Energetic Oltenia (30.4% market share), Hidroelectrica (22.8 %), Nuclearelectrica (20.2 %), Electrocentrale Bucharest (6.4 %) and Complexul Energetic Hunedoara (5.9%). (ANRE, 2012).

Our approach allows drawing an image of the energy units' regional distribution in Romania (figure 2, table 1). On the basis of this synthetic information, we can deduct a series of conclusions regarding the existing and prospective regional distribution of the Romanian energy system.

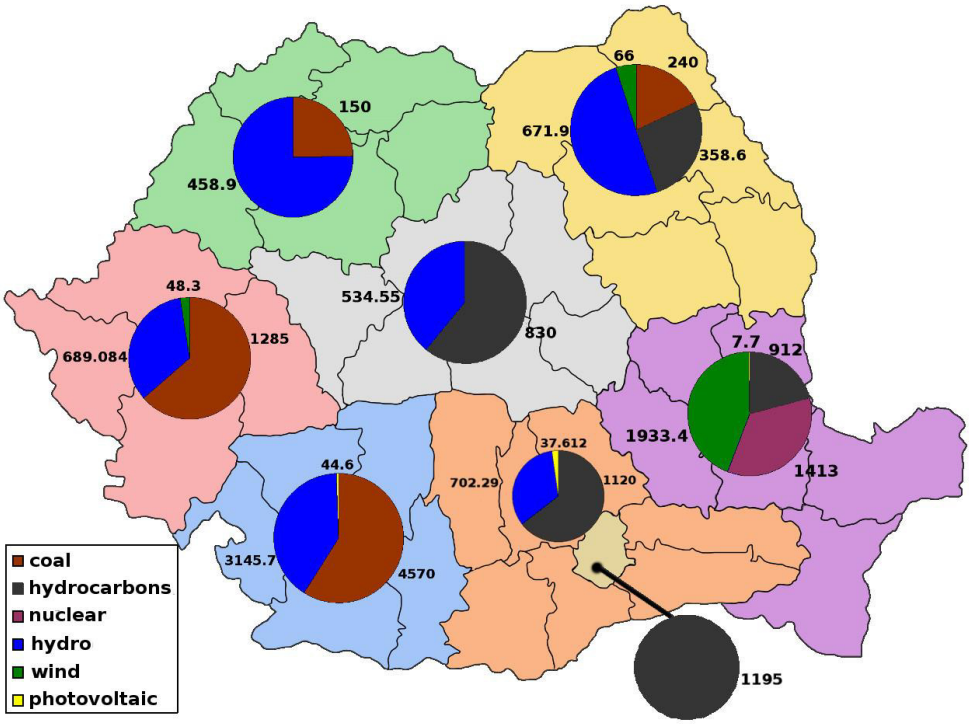


Figure 2 The regional structure of the installed energy capacities (MW) in Romania in 2013
Source: Own calculations based on the data provided by Transelectrica (www.transelectrica.ro)

Table 1:The regional structure of the Romanian energy systems' installed capacities in 2013 and estimations for the 2020 year, the employees number and the profits/losses (estimations for 2012)

Region	Energy resource	Installed capacity in 2013 (MW)	Installed capacity decomissioned until 2020 (MW)	Installed capacity in 2020 (MW)	Employees (no)	Profits/ Losses (mil. euro)
Region 1 – Bucharest-Ilfov	Hydrocarbons	1195	1x50(2017) 1x125(2018)	1020	2415	8,4
	Total	1195		1020	2415	8,4
Region 2 - Centre	Hydrocarbons	830	200 (2016)	630	482	5,9
	Hydro	534.55		534,55	448	- 9,8
	Total	1364,55		1164,55	930	- 3,9
Region 3- North-East	Coal	240	2x60 1x60	60	1162	- 8,4
	Hydrocarbons	358.6	1x210(2019) 2x60	28,6	30	- 0,25
	Hydro	671.9		671,9	563	- 12,4
	Wind	66		66	6	- 1,3
	Total	1336,5		797,9	1761	-22,35
Region 4 - North –West	Coal	150	2x25 2x50	0	964	- 10,3
	Hydro	458,9		458,9	385	-8,4
	Total	608,9		458,9	1349	- 18,7
Region 5- West	Coal	1285	1x210(2017) 1x60	1015	2500	- 3,9
	Hydro	689,084		689,084	577	- 12,7
	Wind	48,3		48,3	10	5,4
	Total	2022.384		1752,384	3087	- 11,2

Region	Energy resource	Installed capacity in 2013 (MW)	Installed capacity decomissioned until 2020 (MW)	Installed capacity in 2020 (MW)	Employees (no)	Profits/ Losses (mil. euro)
Region 6 - South-West	Coal	4570	1x330(2018) 1x100	4140	10781	- 14,9
	Hydro	3145,7		3145,7	2637	- 57,8
	Solar	44.6		44.6	0	0,4
	Total	7760.3		7330,3	13418	- 72,3
Region 7 - South	Hydrocarbons	1120		1120	906	7,65
	Hydro	702,29		702,29	589	-12,9
	Solar	37.612		37.612	4	0,8
	Total	1859,9		1859,9	1499	- 4,45
Region 8 - South-East	Hydrocarbons	912		912	1042	- 15,8
	Nuclear	1413		1413	2136	7,7
	Wind	1933,4		1933,4	174	8,5
	Solar	7.7		7.7	2	0,4
	Total	4266,1		4266,1	3354	0,8
Total installed capacity	Coal	6245,0	1030	5215	15407	- 37,5
	Hydrocarbons	4415,6	705	3710,6	4875	5,9
	Nuclear	1413,0	0	1413,0	2136	7,7
	Hydro	6202,4	0	6202,4	5199	- 114,0
	Wind	2047,7	0	2047,7	190	12,6
	Solar	89,9	0	89,9	6	1,6
	Total	20413,6	1735	18678,6	27813	- 123,7

Source: Own calculations based on the data offered by Transelectrica and the Ministry of Finance

3. Conclusions

Regarding the regional structure of the electricity generation capacities:

- As we mentioned before, the equilibrium of the energy capacities is determined mainly by the endowment with primary energy resources of the respective perimeters. This influences the share of the installed capacity of the regions in the national total. Thus the regions S-W and S-E administered, in 2013, almost 60% of the production capacities of the energy system (figure 3 a).

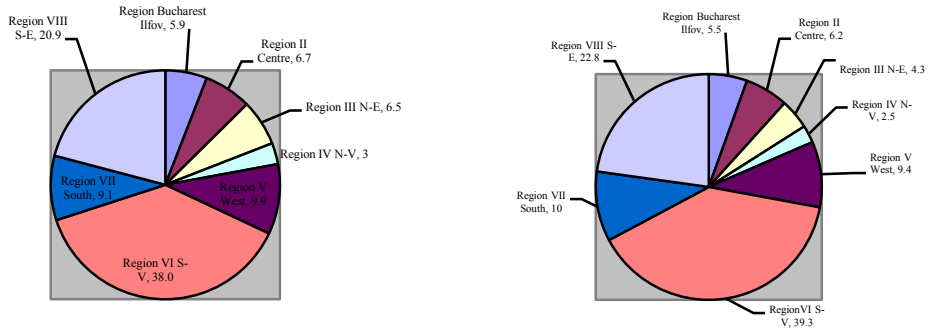


Figure 3 a), b). The regional structure of the Romanian installed electricity generation capacities in 2013 (a) and estimates for 2020 (b). Source: Own calculations of the data provided by Transelectrica and, for 2020, „Elemente pentru evaluarea Aplicației trimisă de România în conformitate cu Articolul 10c(6) al Directivei 2003/87/CE Revizia 4 / 22.06.2012, pg.24".

- The structural previewed changes for the next years (as certitudes – the closure of numerous generation capacities functioning on fossil resources as a result of the financing lack, the growth of the wind farms share and, as a wish – the eventuality of nuclear units expansion etc) will enhance the regional disparities even more (in 2013, the average of the absolute deviations of the data points from their mean was 8.5, comparing to 9.3 estimated for

2020, taking into account only the decommissioning of coal and hydrocarbons based generation capacities. (figure 3 b)

- The addition of generation capacities in the S-E region of approximate 1500 MW in wind farms and 1400 MW in two nuclear units would result in, *ceteris paribus,* a share of this region of over 30% from the national total. Together, the S-E and S-W regions will get to over 70% of the total. This situation will impose significant investments in electricity transport networks and backup units in order to avoid congestions.
- The resources distribution determines the regional structure of the generation capacities by fuel. Thus, the S-W and West regions are dominated by coal based energy units; the Centre relies on hydrocarbons and hydro energy; the N-W and N-E regions, forced by the drastic reduction of the coal and hydrocarbons capacities, have to rely on hydro plants. The wind potential of the S-E region triggered, in the last years, the energy balance of this area towards this type of generation capacities;

Regarding the regional labour endowment of the electricity generation capacities:

- It can be easily observed a major disparity regarding the employees' distribution. The S-W region employed in the energy production, in 2012, almost half of the human resources. The S-E and West regions followed at a considerable distance (figure 4).

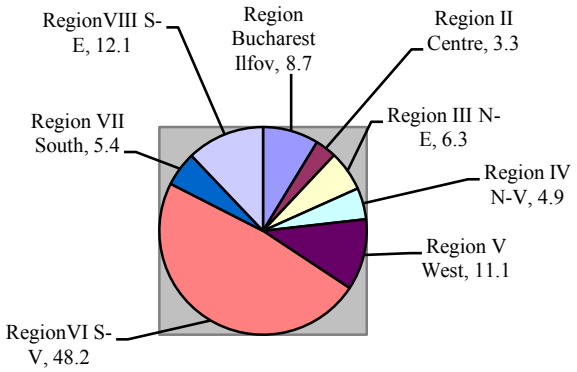


Figure 4 The regional structure of the human resources endowment of the Romanian electricity generation capacities in 2012:
Source: Own calculations of the data provided by the Ministry of Finance (www.mfinante.ro)

- From the perspective of the relationship between generation capacities and their labour endowment (figure 5), we can notice that the S-W and West regions, having similar generation capacities structures by type of resources (with the presence in both cases of coal energy complexes - CE Oltenia, respectively CE Hunedoara), use an average number of employees of 1.7 respectively 1.5 for each installed MW. In return, the S-E region, dominated by wind farms with a very low number of employees per capacity unit (0.09), benefits from an average of 0.8 persons/MW, although the nuclear plant has a similar level of labour intensity (1.5 persons/MW) with the rest of the regions. The Bucharest-Ilfov region utilizes the most important number of employees for each installed MW (2.4). The main explanation comes from the fact that the regions' energy production is realized in thermal and electricity cogeneration plants, meaning that, beside electricity, these units supply a huge quantity of thermal energy in specialized generation capacities not taken into account in this study.

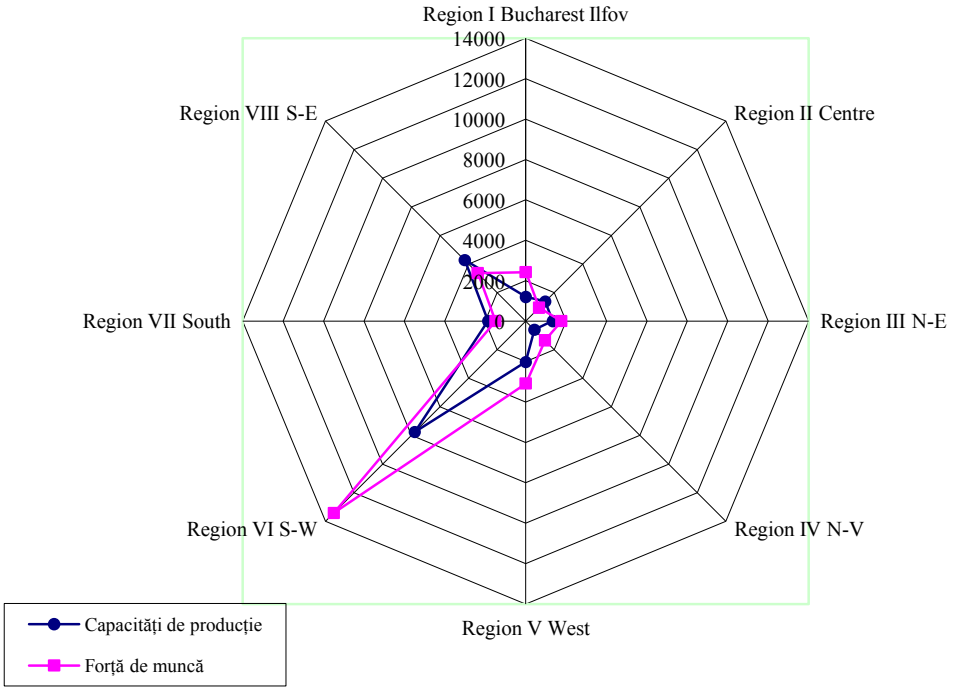


Figure 5. The illustration of the relationship between the electricity generation capacities and their labour endowment
Surse: Own calculations of the data provided by the Ministry of Finance (www.mfinante.ro) and Transelectrica (www.transelectrica.ro)

- As a result, the structural previewed changes will conduct to a decrease of the number of employed persons in the sector due to the closure of a whole series of cogeneration plants, more labour intensive, and due to the expansion of the wind farms. This tendency will be countered by the necessity of new investments in reserve capacities destined to offset the intermittent character of the wind energy and in the two new nuclear units at Cernavoda. An energy strategy would be able to clarify the education sectors' orientations in the perspective of more adaptive scholar *curricula*.

Regarding the economic and financial situation of the electricity generation capacities

- The majority of companies that administer cogeneration plants are in a state of insolvency or in liquidation. In fact, the electricity and thermal energy generation companies administered by local councils have a precarious financial situation due to the very low investment capacity of the new owners.
- At the generation level, the energy system registers, taking into account the 2012 estimations, losses that sum 123.7 million Euros. A major contribution to these losses had Hidroelectrica, the reasons for this situation being approached widely in the press and in our previous papers (Badileanu M., 2013). Contrary to the expectations, the hydrocarbon based capacities benefited, generally, from profits, with the exception of CET Galati. The company "managed" to turn the balance to minus. Profitable is also the nuclear activity and, on average, the wind farms' activity, supported through the green certificates system. The coal was unprofitable that year, regardless the region. Consequently, the only regions that proved their profitability were, in 2012, Bucharest-Ilfov and S-E.

If the generation sector is struggling for survival being submitted to continuous transformations, more or less coherent, the distribution sector managed to benefit fully from its privileged position "closer" to the paying client and from the advantages of foreign direct investments provided by ENEL, E.On and CEZ.

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